Nilkanth Chapole

From: Nilkanth Chapole
Sent: 20 September 2022 15:32
To: bimal@qsutra.com
Cc: mts@qsutra.com; mx@qsutra.com
Subject: RE: Technical query on Generalized Variance Chart, with subgroup size of 1

Dear Mr. Bimal,
Appreciate your time on the query
Thanks!! for the explanation and it was helpful.

Thank You!!

Regards,
Nilkanth
AGM-Corporate Quality.
Granules India Ltd.
Hyderabad.

From: bimal@qsutra.com <bimal@qsutra.com>
Sent: 19 September 2022 13:02
To: Nilkanth Chapole <Nilkanth.Chapole@granulesindia.com>
Cc: mts@qsutra.com; mx@qsutra.com
Subject: RE: Technical query on Generalized Variance Chart, with subgroup size of 1

Dear Mr. Nilkanth,

Thank you for your mail!

1. In the article we can see how it has been defined *If no subgroups exist, all formulas for the Generalized Variance chart cannot be calculated. In this case, Minitab standardizes all values by subtracting the appropriate column mean and then dividing by the square root of the appropriate variance from the covariance matrix of all the data.*

2. So, for each value on the column of original data you subtract the mean of that column and divide that by the square root of the value that appears in the relevant position on the sample variance covariance matrix. Please note that for the sample variance-covariance Matrix, Minitab uses the approach here when subgroup size = 1: https://support.minitab.com/en-us/minitab/21/help-and-how-to/quality-and-process-improvement/control-charts/how-to/multivariate-charts/tsquared-generalized-variance-chart/methods-and-formulas/methods-and-formulas-for-tsquared-chart/ find where it says S for individual observations

3. Individual observations

When data are individual observations, T^2 is calculated as follows:

$$T^2 = n(x - \bar{x})' S^{-1}(x - \bar{x})$$

where:

$$S = \frac{1}{2(m-1)} \sum_{i=1}^{m-1} v_i v_i$$

where:

$$v_i = x_{i+1} - x_i$$

4. Once you have transformed the original values like that, then you build the chart as if it was a normal **S chart with subgroups across the rows**.

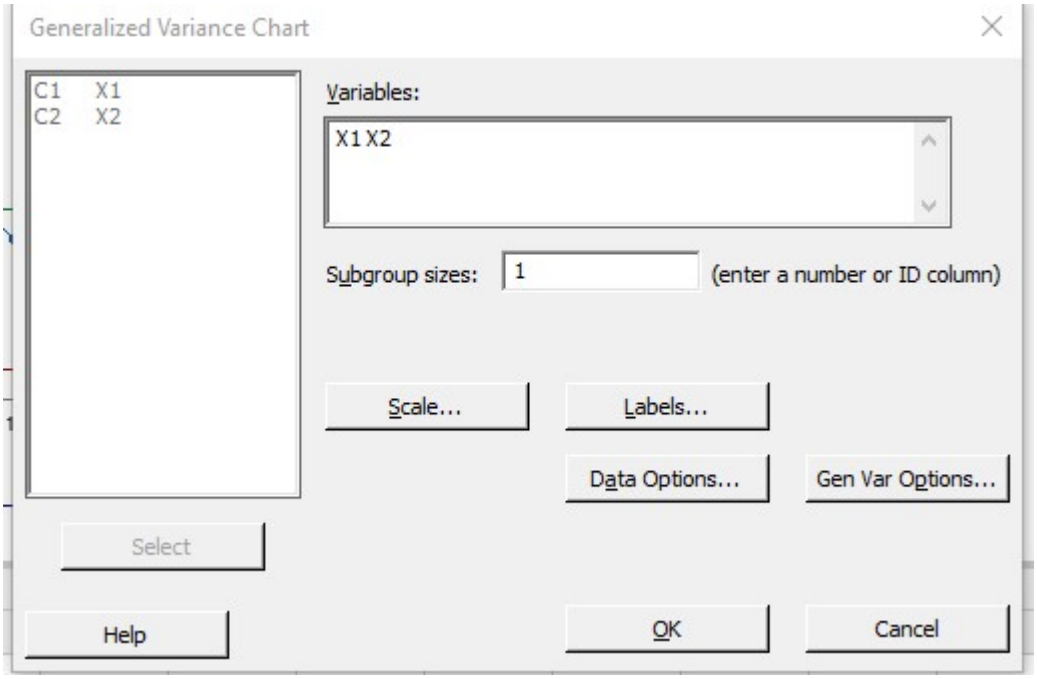
For example,

Let's say you have the following data.

X1	X2
12.78	31.2881
14.97	38.1993
15.43	38.8387
14.95	37.4431
16.17	41.4101
17.25	43.3266
16.57	39.6343
19.31	48.0613
18.75	48.3875
16.99	43.4925
18.20	44.2329
16.20	40.9430
14.72	35.2621
11.02	28.9415

Go to Stat > Control Charts > Multivariate Charts > Generalized Variance

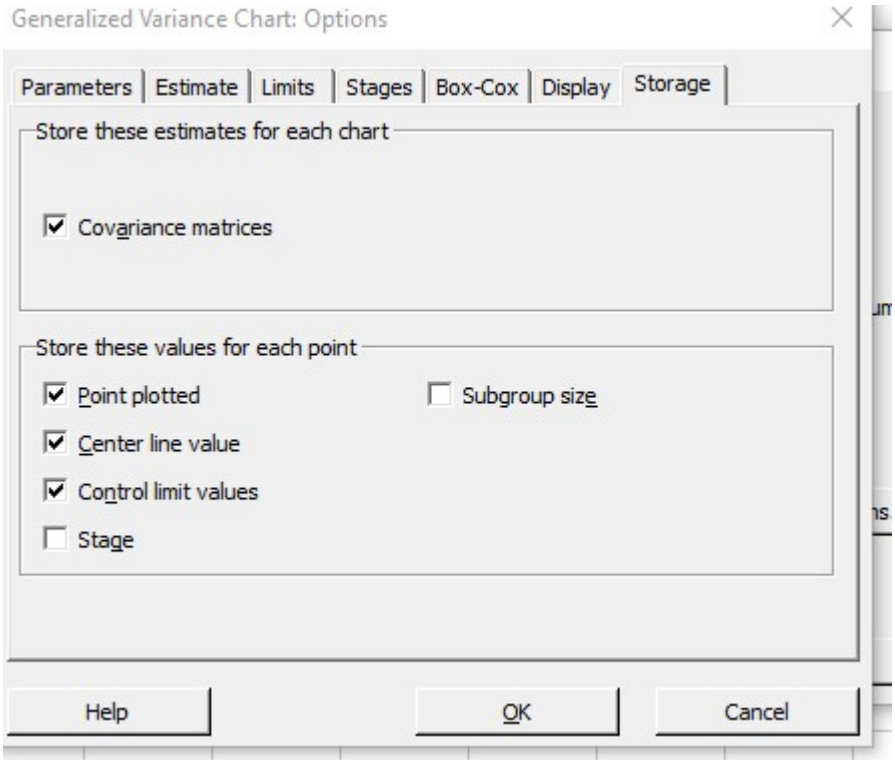
Put the values as shown here:



Click on Gen Var Options

Click on Storage

Choose Covariance Matrices
Choose Point Plotted
Center Line
Control Limit Values



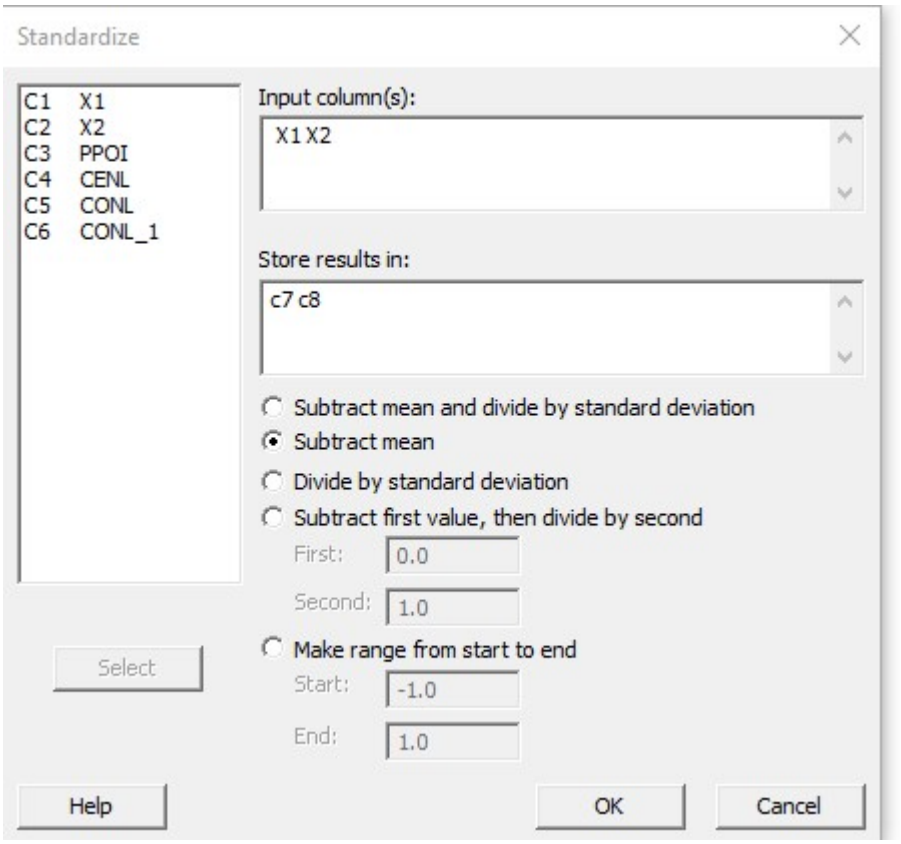
Click ok

Click Ok

You will get the chart and all the information you requested to store.

Now, let's work out how each point is plotted etc.

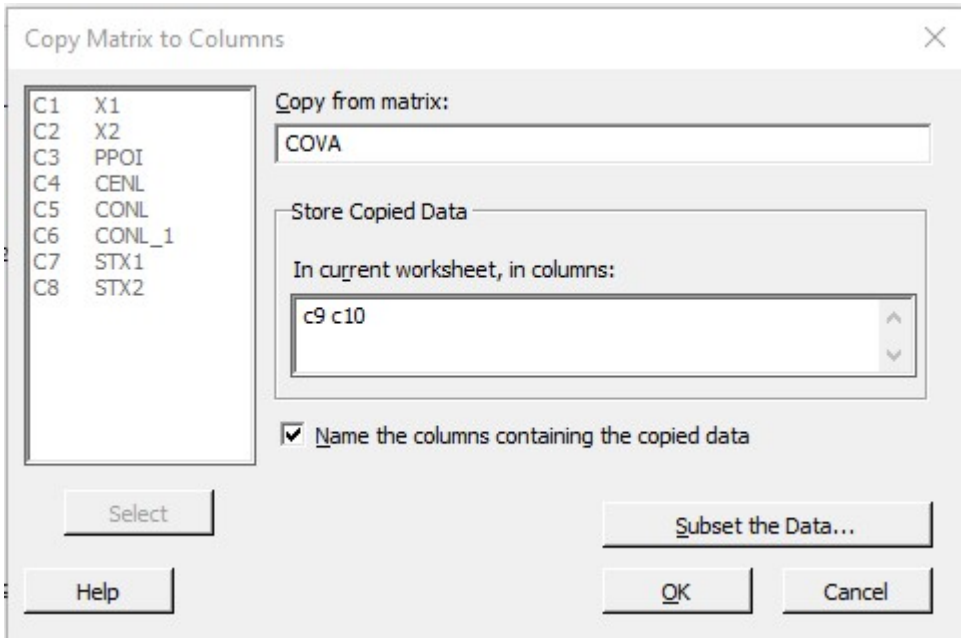
1. Take the mean value of each variable and store on a different column, go to calc>Standardize>fill in as follows



Click OK

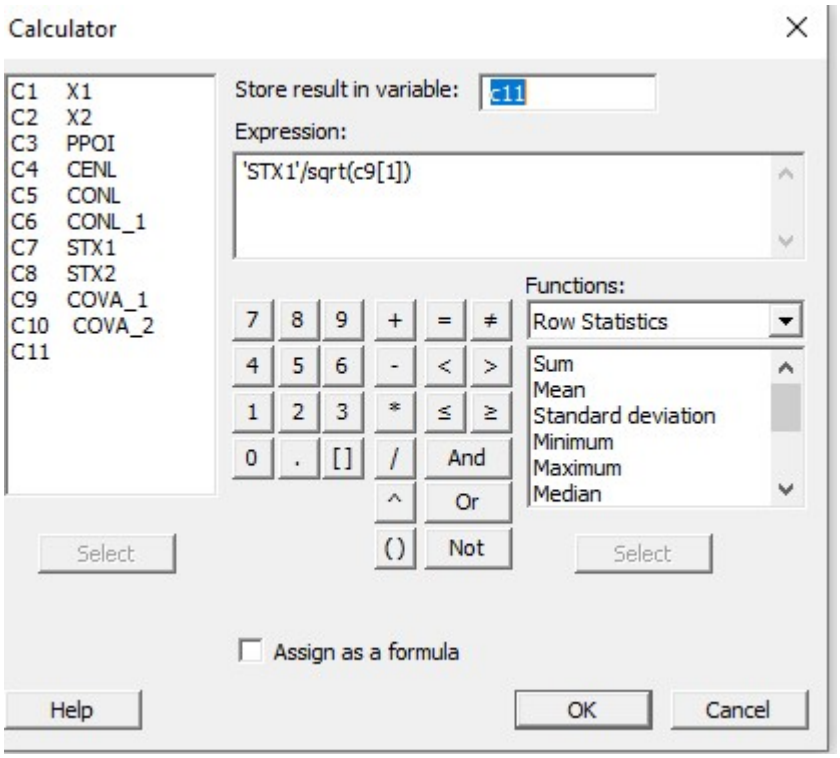
I gave them the name StX1 and STX2

2. Show the Covariance Matrix you obtain from the control chart when generating it and copy it to columns c9 c10.
   Go to Data > Copy > Matrix to Column do as follows

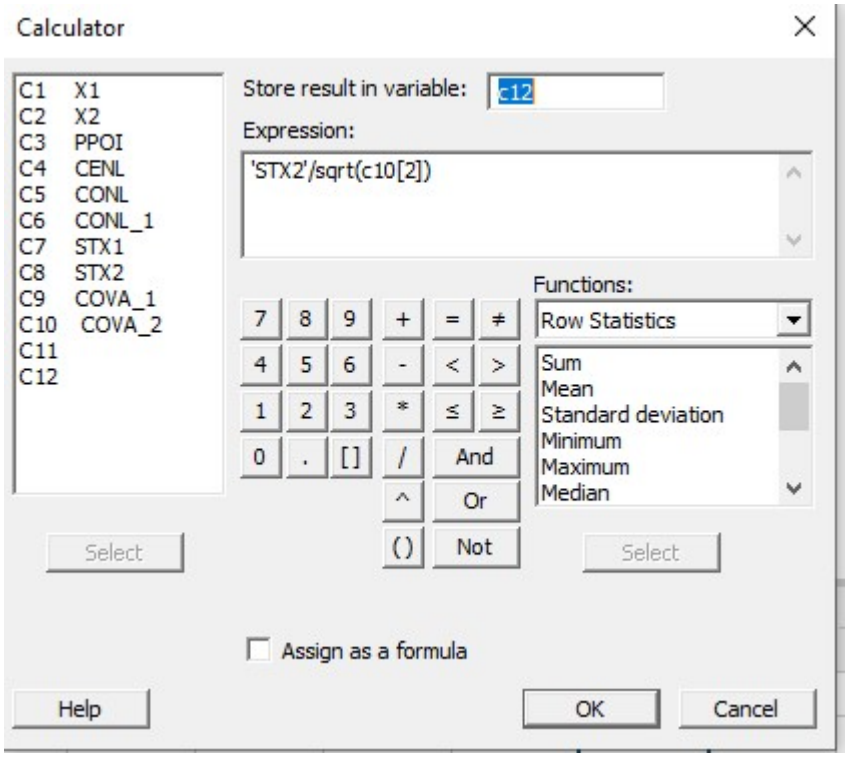


Click Ok

3. You will see the matrix of covariance there, the variance of the first variable will be on the first cell of column c9 = 1.56225 whereas the variance of the second variable will be on the second cell of column c10.
4. Divide each variable STX1 and STX2 by their respective standard deviations using the values from the Matrix. For the first one go to Calc> Calculator >



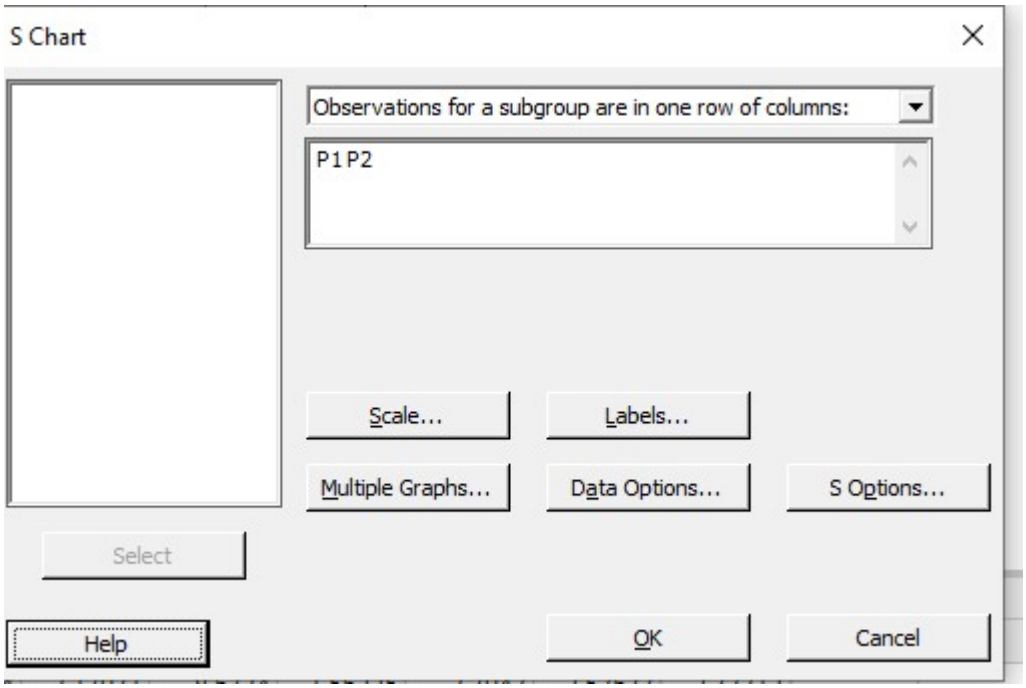
Repeat for the second one store on c12



Now I called each Resulting Column P1 P2

From this moment, you can use the Stat > Control Charts > Variable Chart for Subgroups > S on the columns P1 and P2 using the option observations are in one row of columns and it will render the same chart as the Generalized Variance Chart of original X1,X2.

Meaning that, the methods and formulas for plotted points etc are going to be the same as they are for the S chart here: https://support.minitab.com/en-us/minitab/21/help-and-how-to/quality-and-process-improvement/control-charts/how-to/variables-charts-for-subgroups/s-chart/methods-and-formulas/s-chart/ but with P1 and P2.



I hope this helps.

Best Regards
Bimal

From: Nilkanth Chapole <Nilkanth.Chapole@granulesindia.com>
Sent: 16 September 2022 06:18 PM
To: bimal@qsutra.com
Cc: mts@qsutra.com; mx@qsutra.com
Subject: RE: Technical query on Generalized Variance Chart, with subgroup size of 1

Hello Mr/Miss.Bimal,
I am experience user and as informed prior,
I had referred to the shared page.

Formula is not included for generalized variance with subgroup size of 1.

For more clarity on query, please check for first email and or call me on 76750 11338.
Please.

Regards,
Nilkanth

From: bimal@qsutra.com <bimal@qsutra.com>
Sent: 16 September 2022 14:08
To: Nilkanth Chapole <Nilkanth.Chapole@granulesindia.com>
Cc: mts@qsutra.com; mx@qsutra.com
Subject: RE: Technical query on Generalized Variance Chart, with subgroup size of 1

Dear Mr. Nilkanth,

Thank you for your mail!

Regarding your below query, please find the below link where required formulas are there.

Methods and formulas for Generalized Variance Chart - Minitab

Best Regards
Bimal

From: Nilkanth Chapole <Nilkanth.Chapole@granulesindia.com>
Sent: 16 September 2022 11:56
To: mts@qsutra.com
Subject: Technical query on Generalized Variance Chart, with subgroup size of 1

Dear Minitab Technical Team,
I am using Minitab for multivariate control chart and

interested to know the formula which Minitab considers for calculation of Generalized variance with subgroup size/ sample size of 1 and the control chart limit.

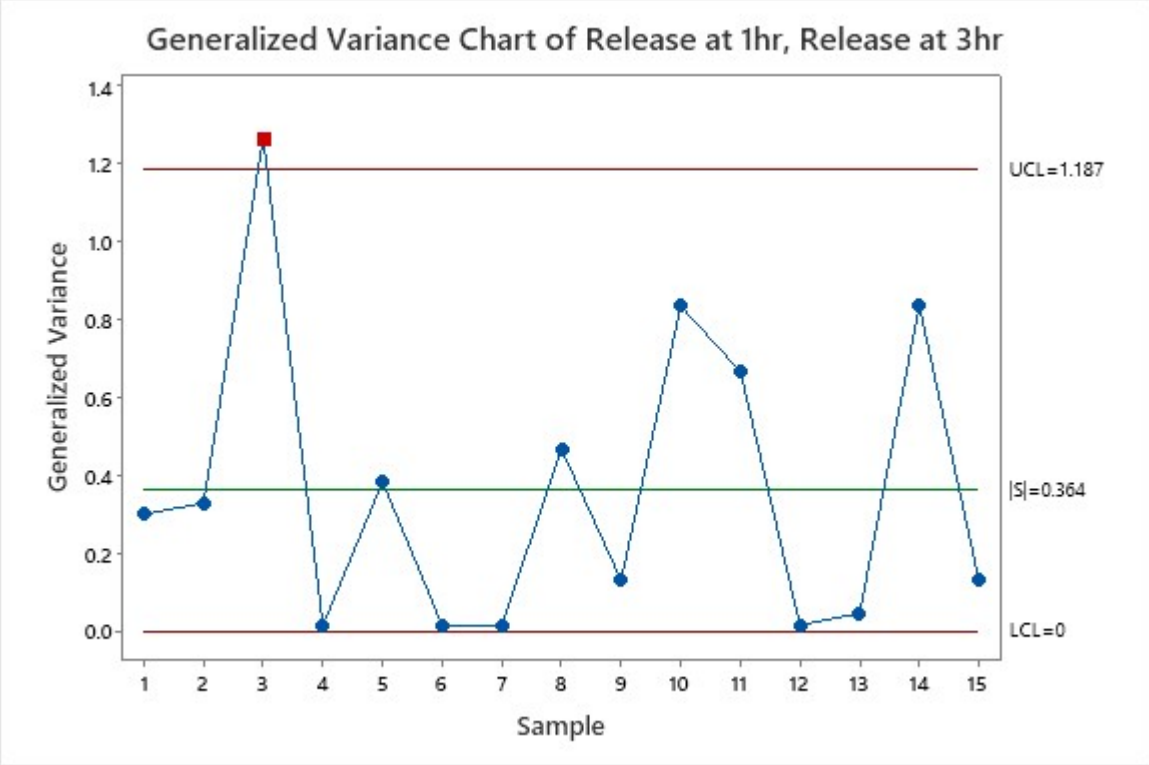
I am using Minitab® 21.1.1 (64-bit) and had checked in Minitab help on required formula.
Also, checked some textbooks on statistical quality control, however I was not able to get the required formula(s).

With the following set of data and required formulas, I am interested to manually calculate the generalize variance values for each observation and control chart limits.
Please help.

Input Data Set:

Release at 1hr	Release at 3hr
77	99
79	103
79	99
78	101
78	100
78	101
78	101
79	101
75	97
73	97
75	99
78	101
74	96
73	97
75	97

Control chart, Output: using Minitab 21



Thanks!

Regards,
Nilkanth